How equal is the electoral representation in municipalities? A study of disproportionality in Polish local councils

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Konferenzbeitrag / conference paper

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ECPR General Conference, Glasgow, 3-6.09.2014

Abstract

The disproportionality is one of the main problems of political representation. Nonetheless, the empirical research on disproportionality in local councils occurs only as an exception. In our paper we demonstrate how disproportionality can be studied at the local level. Following van Puyenbroeck (2008), we distinguish the postulates of "equally treated voters" and "equally treated parties" which are the basis for the assessment of disproportionality. Using the results of recent Polish local elections (2010), we demonstrate how the disproportionality varies between the municipalities of different size, using different electoral formulae, how it is affected by the electoral districting, seat apportionment and local differences in turnout. Moreover, as a preparation for the empirical study of the electoral reform, effective in 2014 (November) elections, we formulate several hypotheses on how the introduction of single-member districts would affect political representation at the local level.

The paper is a result of the research project no. 2013/09/N/HS5/00276 financed by the National Science Center.

Introduction

The aim of this paper is twofold. Firstly, we would like to analyse the disproportionality in the elections of local councils pointing the main factors leading to the larger equality of citizens' votes. The example of Poland is interesting in the comparative perspective, as the electoral system in Polish local elections combines the proportional and majoritarian rules. Moreover, it is also a subject to a considerable reform, effective in the up-coming 2014 elections, which will strengthen the majoritarian formula at the expense of proportional one. At this stage of our research project, aiming to assess the outcomes of the reform, we base our analyses on the results of 2010 elections and present some hypotheses concerning the potential consequences of the reform which could be visible in 2014 elections.

Secondly, and more broadly, we would like to present in this paper some theoretical and methodological considerations on disproportionality and its measurement. Our aim is to develop the approach towards disproportionality known from the electoral studies and formal political theory. We introduce the concept of "components of disproportionality": between-district component measuring the bias caused by the seats apportionment between electoral districts and within-district component measuring the bias caused by the seats apportionment between parties or candidates. We calculate these components in our empirical analyses and, subsequently, try to explain their variation using the main features of local electoral system as explanatory variables.

In the following parts of our paper, we present the idea of elections as an institution designed to distribute the political representation. Such an approach couples the concept of disproportionality with the assessment of the distribution of political representation. We discuss the idea of "equal vote" which can be understood either as a postulate of voters' equality or parties' equality; the former being less disputable than the latter which is specific for the proportional representation systems. We observe that disproportionality in the majority of electoral systems stems from two sources: the seats apportionment between electoral districts and the seats apportionment within districts. In order to measure these two components, we propose a new variance-based indicator of disproportionality which could be easily decomposed into this two components. We briefly discuss its formal properties.

We open the empirical part of our paper with the short description of the local governments in Poland and the main characteristics of the electoral system. Subsequently, we present the variables used in our analyses and main hypotheses which are tested. Using the OLS

regression, we identify the main determinants of two components of disproportionality. We end our paper with conclusions and hypotheses concerning the electoral reform which will affect 2014 local elections in Poland.

Political representation and disproportionality at the local level

The research on disproportionality is a classical part of electoral studies. Existing studies are focused mainly on the relationship between the electoral formulae and the similarity between votes' and seats' distribution. In the dominant approach, the more similar these two distributions are, the more proportional we consider the elections (Rae, 1967; Loosemore, Hanby, 1971; Taagepera, Shugart, 1989; Gallagher, 1991; Benoit, 2000; Cox, Shuggart, 1991). It is also worth noticing that the existing empirical studies on disproportionality refer mainly to the parliamentary elections, with only few exceptions dealing with the local level elections (e.g. Dunleavy, Margetts, 1999; Rallings, Johnston, Thrasher, 2004; Bennie, 2006; Norman et al., 2007; Curtice, 2007). It is possible that due to the smaller significance of "second-order" local elections and its results, in comparison to the "first-order" parliamentary elections, the electoral rules and the postulates of "vote equality" at the local level are less disputable. Difficulties in access to the comparable detailed local election results in various countries also play a significant role. However, even single-country studies focused on local elections, which are held simultaneously in hundreds or even thousands municipalities, provide large amounts of data which are very useful in analyses of electoral mechanisms.

Before we proceed to the discussion on disproportionality, it is necessary to make certain caveats concerning electoral representation at the local level. Although the elections of local councillors and parliamentary elections are formally very similar, one should notice some differences between the electoral mechanisms ensuring political representation at local and national level.

Firstly, local elections, as all local politics, operate in a larger spatial resolution. If municipalities are divided into electoral districts, this division is fine-grained in comparison to the division of the whole country into electoral districts in parliamentary elections. The small size of electoral districts in local elections has numerous well-known advantages, as well as small size of municipalities: it allows for direct electoral campaigning; voters and their representatives know each other more frequently, as they can be neighbours; the

accountability of councillors can be embedded in the dense network of direct contacts. However, small size of electoral districts implies also that the local elections are more vulnerable to the inequalities in the distribution of political representation among citizens, stemming from the dynamic changes in the spatial distribution of the electorate, differences in turnout level between electoral districts and tactically-motivated redistricting (gerrymandering).

Secondly, as municipalities usually differ greatly in terms of size, the number of citizens per one councillor is much smaller in smaller municipalities, even if the size of representative bodies (councils) grows along with the size of municipality. Thus, in case of local elections, the postulate of "one vote, one value" from the very beginning is somehow relative, limited to a single municipality.

Thirdly, a variety of actors participate in local elections – not only nation-wide political parties, which dominate parliamentary elections, but also small parties, local lists and independents (Copus et al., 2012). Local electoral systems have different formats, local councils can be either significantly fragmented due to the large amount of parties participating in the elections or dominated by one group of councillors. On the one hand, it is easier to enter the local than the national electoral market. But on the other hand, in small and peripheral municipalities the electoral market in local elections can be much narrower than in the national elections, due to the insufficient supply of candidates. In the extreme situation, local elections can be non-competitive (or uncontested, when the number of candidates is equal or lower than number of representatives to be elected) – it means that the political representation could be, in fact, provided without elections. Such a situation is rather exceptional in parliamentary elections.

Fourthly, the party coherence, as well as party discipline in local councils may be weaker, not only in the case of non-partisan local lists but also in local branches of political parties. Territorial loyalties can play a greater role than party loyalties in explaining councillors' legislative behaviour, particularly in the case of the decisions concerning local investments or spatial planning. The importance of the territorial loyalties strengthens the postulates of equal representation of natural (traditional) sub-municipal territorial units, such as villages or boroughs, even if they are not densely populated.

Context: local democracy and local elections in Poland

Our analyses of disproportionality are based on the case of Poland where municipalities with democratically elected councils have existed since 1990 (it was one of the results of the Roundtable agreements and the victory of "Solidarity" movement in 1989 parliamentary elections). Since 1999, the country has the three-tier territorial structure with 2479 municipalities (*gminy*), 381 counties (*powiaty*), 66 of them are cities of county status, and 16 regions (*województwa*). However, the municipal tier remains not only the oldest, but also the most important tier of sub-national government (the aggregate budget of Polish municipalities is close to 75% of all decentralized spending). Polish municipalities are relatively big, compared to those in many other European countries. The average population size is close to 16,000 inhabitants. None of the municipalities has the population lower than 1000 (Swianiewicz, 2011).

Local elections in Poland are organized every four years (1990, 1994, 1998, 2002, 2006, current local councils were elected in 2010, the next election will be held in November 2014). Since 1998, the municipal elections are accompanied by the elections of upper-tiers assemblies: county councils (*Rady powiatu*) and regional assemblies (*Sejmiki*). Warsaw citizens elect also district councils (*Rady dzielnic*). Since 2002 direct election of mayors were introduced in all Polish municipalities (executive boards of counties and regions are still appointed by the assemblies).

The electoral system at the local level has been changing substantially since 1990. However, it remains a combination of majoritarian rule (plurality voting - "first-past-the-post" in single- and multi-member electoral districts) in small municipalities and proportional rule (PR) with open lists in larger cities. Until 2010, the threshold between "smaller" and "bigger" municipalities, thus between FPTP and PR systems, was 20,000 inhabitants (40,000 inhabitants in 1990 and 1994 elections). Municipal councils in Poland count from 15 councilors in the smallest municipalities (having up to 20,000 residents) up to 45 councilors in the largest cities and (exceptionally) 60 in the capital city of Warsaw.

Municipal councils are responsible for delimiting electoral districts, according to the general rules described in the Electoral Code. Until 2010, the district magnitude could vary from 1 to 5 seats in FPTP system and from 5 to 8 in PR system. In FPTP system, voters were eligible to cast as many valid votes as the number of seats allocated to the district. It complicated the act of voting and allowed for ticket-splitting in the ballot.

The electoral reform adopted by the parliament in 2011 (effective in 2014 elections) strengthened and "purified" the majoritarian elections at the local level. By "strengthening", we mean the introduction of the majoritarian rule in the municipalities where proportional elections were held previously. In 2014 local elections, the PR system will be used only in 66 largest cities (of county status)[1]. Councils in all other municipalities will be elected with the use of single-member districts. By "purification" of the majoritarian system we mean that the multi-member districts (relatively rare in majoritarian systems) will not be allowed. In the last section of this paper we discuss some of the potential consequences of these changes in electoral law.

One of the main publicly expressed expectations from the reform is the growth of accountability and civic engagement at the local level. Nonetheless, our research project focuses on disproportionality as the main direct outcome of the reform. While the idea of proportional elections is present in Polish electoral system since the first democratic parliamentary elections, there is a strong social support for majoritarianism, more precisely – for single-member districts. However, many Polish voters did not have sufficient experience with "purely majoritarian" electoral system. For that reason, changes in the electoral system at the local level are treated sometimes as "a laboratory experiment" before a potential reform of the electoral law at upper tiers of sub-national government and even at the national level.

Disproportionality as a departure from two ideals

In this paper we treat local elections as an institution designed to distribute among citizens (or voters) a very specific common good – political representation in the council. We relate the notion of disproportionality to the problem of equal (fair) distribution of political representation. In this respect, we depart somehow from the dominant way of defining disproportionality in the political science where it is a result of comparison between votes' and seats' distributions for all parties participating in the elections.

In political science, we can distinguish two ways of conceptualizing and measuring disproportionality (Gallagher, 1991: 38; Taagepera, Grofman, 2003; van Puyenbroeck, 2008). The first, dominant approach is concentrated on the outcome for parties (lists) participating in

[1] Moreover, maximum district magnitude in municipalities with the PR system will minimally increase to 10 seats (previously 8).

the ballot: it assumes that the disproportionality occurs when the distribution of seats in a representative body departs from the distribution of votes casted in the ballot. Only when seat shares are equal to respective vote shares, the outcome is considered perfectly proportional. In order to measure the degree of disproportionality, one should know **differences** in two distributions (of votes and seats) for each party (list) which participated in the elections. The most frequently used indices of disproportionality, including these proposed by Loosemore and Hanby (1971) or Gallagher (1991), are based on the differences between votes' and seats' share for each party (Taagepera, Grofman, 2003).

The second approach assumes that the disproportionality is the variation of vote strength, which is defined as a **ratio** between the number of seats won by a certain party (list) and number of votes casted for this party. The amount of representation (more precisely – the amount of seat in the representative body *per capita*) varies between voters due to the assignment of seats which is done according to electoral rules; the larger this variation is, the larger inequality among voters we observe – it implies the larger disproportionality of the elections. The perfect proportionality can be achieved when each voter has the same vote strength – it would be possible if the distributions of votes and seats were identical. The second approach could be easily linked to the research on income inequalities, as far as money and political representation can be treated as goods which can be quantified, divided and distributed between individuals (van Puyenbroeck, 2008: 507-508).

To sum up, the disproportionality can be understood as "unequal treatment" of parties (as in the first approach), or "unequal treatment" of voters (as in the second approach). It should be noticed that both approaches to disproportionality define identically the state of "perfect proportionality" – it occurs when for each party participating in the elections the seats/votes ratio is equal. In reality, this is impossible – seats are indivisible, and electoral systems generally prevent from fragmentation of representative bodies[2]. Nevertheless, two approaches presented above differ in the assessment of disproportionality in other situations. Briefly, they treat differently small and large parties. If we treat parties equally, in the assessment of disproportionality we put more attention to the amounts of political representation ascribed to voters who voted for smaller parties. If we treat voters equally, we put less attention to the amount of political representation ascribed to parties that receive less support.

[2] The analysis of disproportionality in mixed electoral systems, such as STV, is more problematic and in both approaches requires additional, simplifying assumptions (see e.g. Farrell, Katz, 2014).

Each approach is closely related to the rules of seat apportionment in proportional representation systems (PR). If we assume a certain number of seats and distribution of votes in pure proportional elections, the values of disproportionality indices based on the differences between distributions (first approach) are minimized when the largest reminder (Hare-Niemeyer) method is used for seat apportionment. It was proved by Gallagher in his influential article criticizing Loosemore-Hanby index, which is a sum of modules of differences between seats' and votes' shares (Gallagher, 1991: 39). The largest reminders method, as Balinski and Young proved earlier (1982), is not resistant to certain paradoxes of the apportionment.

Nonetheless, the same observation refers to the indices based on the squared differences, thus it refers also to the "sum of squares" index, known as Gallagher's index of disproportionality (van Puyenbroeck, 2008: 521). Therefore, quite paradoxically, the main points of the Gallagher's critique addressed to the Loosemore-Hanby index, remain actual in regard to the "sum of squares" index, as well as the "cosine measure" proposed recently by Koppel and Diskin (2009). More generally, this line of critique remains actual to the "equally treated parties" approach.

The value of disproportionality, defined as a variation of vote strength (second approach), is minimized by the Saint-Laguë (Webster's) method of apportionment which is insensitive to the paradoxes of apportionment (Balinski, Young, 1982: 70-83). This method was actually designed in order to minimize sum of squared differences between vote strength of individual voters and mean vote strength. In consequence, it minimizes also the variance of vote strength and coefficient of variation of vote strength, as well as values of Gini's coefficient (van Puyenbroeck, 2008: 510).

In the following parts of our paper, we use the second approach, despite it is less popular in the comparative political research. It refers to the strength of the vote, thus it treats the political representation as a good distributed primarily among voters.

Two sources of disproportionality

In most of the electoral systems, the distribution of political representation among voters is dependent on the outcomes of two processes regulated by the electoral law: (1) the delimitation of electoral districts and seat apportionment between districts – this process

usually takes place before the elections and affects total disproportionality, (2) the assignment of seats to the representatives (parties and candidates) which takes place after all votes are cast and counted. One can say that the amount of political representation which a voter receives is dependent, respectively, on: (1) where (in which electoral district) he/she lives and votes and (2) which party (candidate) he/she votes for. Of course, it is also dependent on the place where other fellow citizens voted and which parties they supported.

Disproportionality is produced both by the proportional and majoritarian systems, but in the latter the seat apportionment within districts cannot be manipulated like in the former. Therefore, when it comes to assuring "vote equality", the main concern in majoritarian systems is the delimitation of electoral districts and optimal seat apportionment between districts (Balinski, Young, 1982). Under the majoritarian rules, a large amount of votes can be "wasted"[3], particularly in single-member districts. However, as the equal representation of various parties' electorates is not a point for concern in majoritarian logic, the seat apportionment within districts remains fully accepted source of disproportionality, and empirically it is usually considerably larger than in PR systems.

On the other hand, in PR systems, not only the seat apportionment between districts is subject to manipulation, but also the rules of seat assignment within districts (thresholds, electoral quotas etc.). Only in pure PR systems (with single electoral district), which are relatively rare, the seat assignment within districts is the only source of disproportionality. It is expected that the PR system will secure the "vote equality" in two ways: by assuring equal representation for the voters[4] living in various territorial units (electoral districts) and by assuring equal representation for the supporters of different parties.

If we accept that the disproportionality is the variation of the vote strength (political representation *per capita*), and that it is conditioned, both in the PR and majoritarian systems,

[3] „Wasted votes" refer to the proportion of votes casted for candidates or parties which did not receive a seat. It is sometimes interpreted as a share of voters without political representation. In general, this share is larger in majoritarian systems than in PR systems.

[4] It is worth noticing that in most cases, including Polish local elections, the electoral system design takes into account the amount of citizens living in the electoral districts, not the amount of voters who actually participated in the elections (seat apportionment between districts precedes the election day). If there is a considerable variation of turnout level across districts, e.g. due to the varying intensity of electoral mobilization, it is likely that the seats apportionment based on the distribution of citizens would differ from the seats apportionment based on the distribution of actual voters.

by seat apportionment between districts and seat apportionment within districts, we can pose the following questions: how large is the part of the total disproportionality stemming from the former and how large from the latter source? Which factors condition these components of disproportionality?

A new indicator of disproportionality and its decomposition

The "equal voters" approach to disproportionality, which we adopted, suggests the usage of Gini coefficient as a recognized measure of inequality in distribution of political representation. However, it would be difficult to answer the above-mentioned questions using this measure, as it is not decomposable (Sen, Foster, 1997: 153). While it is possible to measure disproportionality with Gini coefficient, it is impossible to present the total disproportionality as a sum of disproportionality of seat apportionment between districts and (weighted mean) disproportionality of seat apportionment between candidates within districts.

Therefore, one could measure disproportionality with another indicator, which refers to the postulates of „voters equality": sum of squared differences between "vote strength" of each voter and mean "vote strength" computed for all voters. It is possible to decompose it similarly as in the ANOVA procedure, its minimum value is 0 and it adopts this value only in the situation of "perfect proportionality" described above. However, its main disadvantage is that its value depends on the absolute number of voters, what makes this measure unsuitable for comparative research, dealing with electoral systems of different size.

One could solve these problems by replacing sum of squared differences by mean of squared differences. In other words, the measure of disproportionality would be a variance of voters "vote strength". This measure is decomposable (following the general scheme of variance decomposition); however, it is still problematic for comparative research, as it refers to the mean value of "vote strength", thus to the "amount of seat" attributed to a single voter. The latter depends on the size of assembly: doubling the number of seats in the assembly would increase variance of "vote strength" by four times (Sen, Foster, 1997: 150).

As a remedy, we propose the usage of coefficient of variation instead of variance. It has a minimum value of 0 in case of the "perfect proportionality" and it has no upper limit. It remains decomposable, what means that total disproportionality can be presented as a sum of between-district and weighted mean within-district disproportionality. What is important,

weights used to calculate the second component should be multiplied by squared ratio between mean "vote strength" within a particular district and mean "vote strength" for all voters (Sen, Foster, 1997: 152).

To sum up, we propose **the coefficient of variation of representation *per capita*** as a measure of disproportionality. The properties of this indicator should be studied more carefully; it seems, however, that it is a very good proxy of Gini coefficient. Using the data from 2010 Polish local elections, we compared the values of the indicator with Gini coefficient. We found very strong correlation (r=0,97); as fig. 1 shows, there is an almost-linear relation between the two measures.

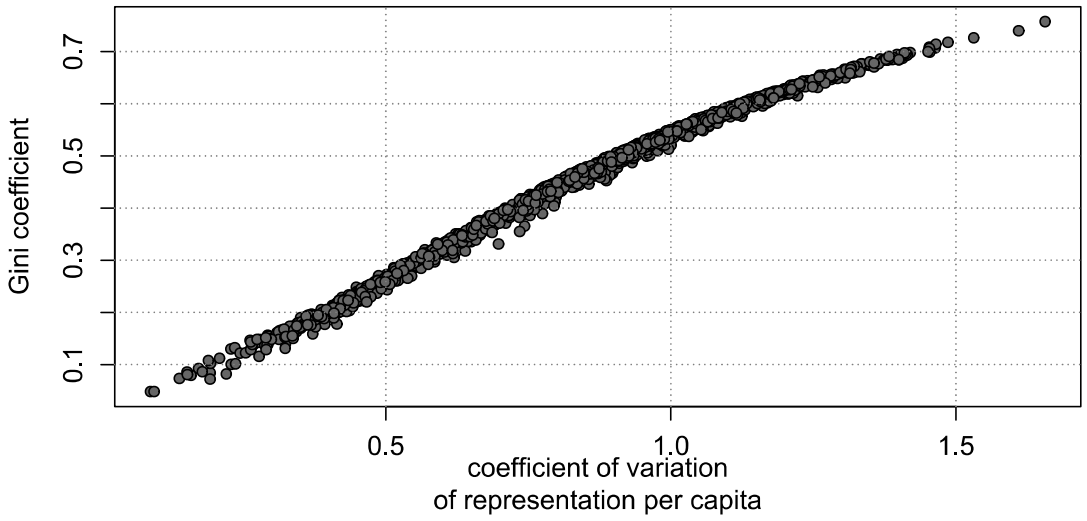

Fig. 1. Empirical comparison of two measures of disproportionality (each point represents one Polish municipality)

Following our considerations about two distinctive sources of disproportionality, in our analyses we decompose total disproportionality into two separate indicators: **between-district disproportionality (BDD)** and **within-district disproportionality (WDD)**. We use the following formulas to calculate them:

$$BDD = \frac{1}{\sum_i v_i} \sum_i v_i \left[\frac{s_i}{v_i} - MRPC \right]^2$$

where summations are over districts and:

v_i is total number of votes casted in *i*-th district;

s_i is number of seats allocated to *i*-th district;

MRPC is mean representation *per capita* $= \frac{\sum_i s_i}{\sum_i v_i}$.

$$WDD = \sum_i w_i D_i$$

where summation is over districts and:

w_i is weight of *i*-th district:

D_i is disproportionality within *i*-th district.

Disproportionality within *i*-th district:

$$D_i = \frac{1}{v_i} \sum_k v_{ik} \left[\frac{s_{ik}}{v_{ik}} - \frac{s_i}{v_i} \right]^2$$

where summation is over parties within *i*-th district and:

v_{ik} is number of votes casted for *k*-th party in *i*-th district;

s_{ik} is number of seats won by *k*-th party in *i*-th district.

Weight of *i*-th district:

$$w_i = \frac{v_i}{\sum_j v_j} \left(\frac{s_i}{v_i} \frac{\sum_j v_j}{\sum_j s_j} \right)^2$$

where summations are over districts.

Data, variables and hypotheses

In our analyses, we use the official results of 2010 local elections, provided by the National Electoral Commission.

Table 1 presents the main features of all 21599 electoral districts in 2010 elections. The threshold of 20,000 inhabitants kept almost a "fifty-fifty" balance between majoritarian and proportional electoral systems: 44% of population lived in smaller municipalities and was eligible to vote under the majoritarian system and 56% of population, including 33% in large cities, lived in electoral districts with PR system. It is worth noticing, that in 2010 the large majority of districts where plurality voting was applied were single-member, but simultaneously they were less populated than multi-member districts (18,5% of eligible voters lived in SMD while 25,5% in multi-member districts). Moreover, majoritarian districts within single municipalities usually varied in their magnitude (number of seats). Only 98 municipalities under the majoritarian system did not have any multi-member districts. Most frequently, the multi-member districts comprised of the largest town or village in the municipality while peripheral villages were located in single-member districts. Table 1 demonstrates that while the PR districts have a generally larger magnitude (number of seats) than FPTP districts, 5-seat districts are the "border case", which occurs in both systems.

Table 1. Main features of the electoral districts in 2010 local elections in Poland

Type of the municipality	District magni-tude	Districts		Eligible voters				
		N	%	Average	Min	Max	Sum (thou-sands)	%
<20,000 inhabitants (FPTP)	**1**	13393	62,0	423	56	1634	5,662	18,5
	2	3931	18,2	826	116	2576	3,248	10,6
	3	1689	7,8	1266	238	3962	2,138	7,0
	4	872	4,0	1631	311	4521	1,422	4,6
	5	494	2,3	2049	366	6069	1,012	3,3
>20,000 inhabitants (PR)	**5**	386	1,8	6468	3535	20824	2,497	8,2
	6	224	1,0	7959	4294	16569	1,783	5,8
	7	194	0,9	8431	4928	19034	1,636	5,3
	8	117	0,5	10027	6054	21873	1,173	3,8
cities of country status (PR)	**5**	161	0,7	28506	7447	111243	4,589	15,0
	6	84	0,4	36439	8774	146745	3,061	10,0
	7	40	0,2	42436	11171	168082	1,697	5,5
	8	14	0,1	50963	12499	185538	713	2,3

From the population of all 2479 municipalities we excluded 425 in which the elections were not fully competitive (i.e. at least in one electoral districts the number of candidates was equal

or smaller than the number of seats). In the remaining 2054 municipalities there were 17075 electoral districts for which we had the basic indicators: number of votes casted for each party (list), number of seats assigned, level of turnout, number of inhabitants. Using them we produced the aggregated variables describing political systems in each of the analyzed municipalities.

As **dependent variables** in the regression analysis we use the components of disproportionality, described in the previous sections of the paper: between-district component (BDD), related to seat apportionment between districts and within-district component (WDD), related to seat apportionment between parties.

In case of multi-member districts number of votes casted for each party was normalized before computing measures of disproportionality, so that the sum of normalized number of votes is equal to the number of voters who participated in the election. It was necessary to treat voters from single-member districts and voters from multi-member districts equally.

While the values of BDD and WDD served as dependent variables, the **independent variables** described the features of electoral systems in each municipality. We present them below, formulating hypotheses concerning their impact on disproportionality. Some of the variables can be relevant predictors for both components of disproportionality, some are proper only for one of the components.

We begin our analysis estimating the basic effect of **Proportional Representation system (PR)**, which is coded as a dummy variable. We assume that both components of disproportionality are lower under the proportional system. In case of within-district disproportionality it is quite obvious: proportional system is designed to minimize this component. In case of between-district disproportionality, we assume that the negative effect of proportional representation occurs mainly due to the smaller size of electoral districts under majoritarian system; in other words, it is probably more difficult to optimally divide a small (in Polish case, predominantly rural) municipality into electoral districts, taking into account the existence of natural territorial units (villages). We assume that after the control variables would be taken into account, the PR effect on disproportionality would disappear.

In the more complicated models, we include additional variables and interactions. Following the studies on the electoral system design, we test the impact of **average district magnitude** in the municipality, which is considered as one of the most important factors affecting

disproportionality (Lijphart, 1990; Taagepera, Shugart, 1989; Gallagher, 1991). When the amount of seats apportioned to a district is larger, less votes are "wasted", thus, the within-district component of disproportionality diminishes. The possibility to create larger electoral districts should also help in assuring similar representation norms in various districts, keeping the traditional territorial units (e.g. borroughs, villages) undivided. Thus, we assume that the average district magnitude has negative effect both on within-district disproportionality and between-district disproportionality. Due to its skewness, this variable was transformed with the $\log_2$ function before it was included in the model.

Additionally, in case of the between-districts component of disproportionality, we test the impact of the **district magnitude variability** (we measure it with the coefficient of variation). We assume that the creation of districts of varying magnitude should help in assuring similar representation norms in various districts, diminishing between-district component.

The other factor traditionally related with the disproportionality is the fragmentation of party system – generally, higher fragmentation leads to higher disproportionality, more precisely – within-district component of disproportionality. In our analyses, as a simple indicator of local party system fragmentation we use the **number of parties participating in the elections** (it includes also local independent lists). However, in many cases parties did not registered their candidates in all districts within a municipality; for that reason, we use the average number of competing parties, calculated for each municipality. As the distribution of this variable is skewed, we use its $\log_2$ in the regression analysis.

In our analyses we pay special attention to the functioning of single-member districts and their impact on disproportionality. Generally, we assume that disproportionality is considerably higher when SMD dominate in the municipality. SMD impact the within-district component of disproportionality, as in competitive districts they produce considerable amounts of "wasted votes". We tested the impact of SMD using two alternative measures: **the share of voters who casted their votes in SMD**, and a dummy variable representing **municipalities in which only SMD were established**. We included them separately, as they convey very similar information to the model. The former variable accounts for the linear effect of SMD dominance in municipalities, while the latter focuses only on the specific group of 98 municipalities divided entirely into SMD (it could be treated as a "group of pioneers" which introduced changes in the local electoral systems before the 2014 reform).

The decisions concerning the delimitation of the districts and seat apportionment between districts is made on the basis of the territorial distribution of eligible voters, few months or even few years before the elections. But as only a part of eligible voters participate in the elections, different part of the electorate in each part of the municipality, the distribution of political representation between voters is biased by the spatial differences in turnout level. In other words, unequal turnout in different parts of the municipality can spoil the equality of voters assured by delimitation of districts and seat apportionment. Generally, voters in the electoral districts with turnout level lower than the average will have larger strength of the vote than voters in the electoral districts with turnout level higher than the average. For that reason, we assume that the turnout variation, measured by the **standard deviation of turnout level within the municipality**, will positively affect between-district disproportionality. There is no reason to expect that the variation of turnout within municipality will affect within-district disproportionality.

In our models we include also, as a control variable, the **size of the municipality** (due to its skewed distribution – its $\log_2$). We assume that the size of municipality has no direct influence on disproportionality, as its impact is mediated by the features of electoral systems, which we study in our analyses and which are significantly different for municipalities of different size.

We complicate our models by adding the **interactions between the dummy variable representing the PR system and all other variables**. This is necessary to understand the differences between two electoral systems under which Polish local elections are held. It is likely that the identified impacts of independent variables have different strength (or even direction) in case of majoritarian electoral system than in case of PR system. Interactions are necessary also because the group of smaller municipalities with majoritarian system is considerably larger than the group of municipalities with PR system (thus the estimates of the effects without interactions could be biased).

We sum up our main hypotheses in the table 2.

Table 2. The determinants of two components of disproportionality – hypotheses tested in our analyses

Variable	Hypothesized impact on between-district disproportionality (BDD)	Hypothesized impact on within-district disproportionality (WDD)
PR system	0	+
Average district magnitude	–	–
District magnitude variability	–	
Dominance of SMD	+	+
Turnout variability	+	
Number of parties		+
Size of the municipality (control variable)	0	0

In order to make the interpretation of the model more meaningful, we fixed the reference level by centering the independent variables. Number of inhabitants was divided (before transformation) by 20,000, what represents the "border value" between majoritarian and PR system. Reference average district magnitude is 5 with SD equal to 0, what represents the municipality with only 5-seats districts, what was actually a possible situation under both electoral systems. Reference levels for standard deviation of turnout and $\log_2$ number of parties were set for the average value in the investigated population of municipalities. Obviously, for dummy variables the reference level is 0 – it represents the majoritarian system and municipalities without SMD.

Results

Before we proceed to the regression analysis, it is worth observing more precisely the dependent variables and their relation. As the table 3, as well as fig. 2, demonstrate, in the case of Polish 2010 local election, WDD visibly dominates BDD, both in small municipalities with FPTP system as in larger municipalities with PR system. It means that the main source of disproportionality (accounting for, on average, 96% of its total amount) is the process of seat apportionment between parties. The variation of vote strength caused by the electoral redistricting is far less important. The share of BDD in total amount of disproportionality is higher than 10% only in extraordinary cases. In other words, the inequality of vote strength occurred mainly due to the party which voters voted for, not due to the place where they

casted their votes. Small share of BDD in Polish local elections is certainly an advantage of the electoral system construction.

Table 3. Indicators of disproportionality in 2010 local elections – descriptive statistics

Indicator	FPTP municipalities			PR municipalities		
	Mean	Min	Max	Mean	Min	Max
Total disproportionality	0,912	0,069	2,744	0,201	0,008	0,665
BDD	0,036	0	0,155	0,006	0	0,029
WDD	0,875	0,051	2,703	0,196	0,007	0,657
% of BDD	4,5	0	31,1	4,0	0	62,5

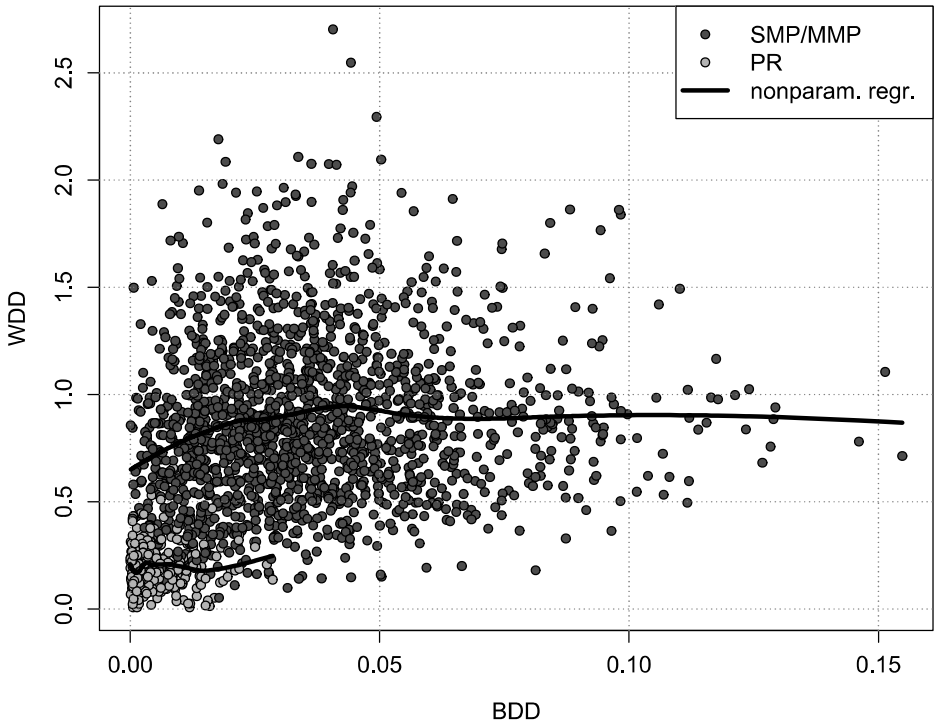

Fig. 2. Relation between the components of disproportionality: between-district (BDD) and within-district (WDD)

Note: each dot represents one municipality: light grey represents larger municipalities with PR system, dark grey represents smaller municipalities with FPTP system.

Nonetheless, apart from the questions on how large disproportionality in Polish local elections was, we search for its main determinants, assuming that two components can be conditioned by different explanatory variables. The results of the OLS regression analyses are presented in Table 4. As the values of BDD are considerably lower than WDD, we present the estimations of BDD determinants with greater precision (4 decimal places). Models 1A and 1B present the basic effect of the electoral system, while models 2A and 2B include all relevant variables and interactions. It can be observed that the full models explain considerably higher amount of BDD and WDD variation – the R^2 coefficient increases from 0,209 to 0,450 and from 0,344 to 0,875, respectively.

The most obvious effect of PR system is negative in case of both components; however, in case of BDD, it diminishes almost to 0 when other variables are included in the regression. It means that the majoritarian rule directly affects only WDD.

The district magnitude (average number of seats in the electoral districts) has a negative effect on both components of disproportionality. In case of BDD it is the most important predictor (Beta = -0,51). The larger the districts, the more proportional the elections, i.e. the more equal is the strength of the vote across districts as well as the more similarities between the distribution of votes and seats. There is also a negative, small but statistically significant effect of district magnitude variability on BDD, what supports our assumption that the electoral districts of diverse size can help in equalizing the vote strength between districts.

It turned out that the usage of SMD impacts positively, in accordance with our assumptions, within-district disproportionality. There was no significant linear effect of SMD dominance on between-district disproportionality when we used the share of voters in SMD as an independent variable. However, there was a small negative effect on between-district disproportionality when we used dummy variable representing municipalities entirely divided into SMD (B=-0,012). The direction of this effect is contrary to our initial hypotheses; however, having in mind the direction of the district magnitude effect, this finding might suggest that the municipalities which are the "pioneers of the reform" succeeded in preserving the equal vote strength despite the use of single-member districts.

Table 4. Determinants of disproportionality in local elections – models summary (OLS regression with robust standard errors)

	Between-District Disproportionality Model 1A	**Within-District Disproportionality Model 1B**	**Between-District Disproportionality Model 2A**	**Within-District Disproportionality Model 2B**
Constant	0,0362 (0,0006)***	0,88 (0,01)***	0,0143 (0,0018)***	0,31 (0,02)***
Proportional Representation system (PR)	-0,0305 (0,0006)***	-0,68 (0,01)***	-0,0014 (0,0021)	-0,13 (0,02)***
$\log_2$(no. of inhabitants[a])			-0,0001 (0,0006)	0,00 (0,01)
$\log_2$(average district magnitude[a])			-0,0153 (0,0010)***	-0,32 (0,02)***
District magnitude variability			-0,0074 (0,0026)**	
% eligible voters in SMD				0,34 (0,04)***
Only SMD in municipality (0-1)			-0,0120 (0,0028)***	
Turnout variability[b]			0,4297 (0,0272)***	
$\log_2$(number of parties) [b]				0,62 (0,01)***
PR x $\log_2$(no. of inhabitants[a])			0,0008 (0,0007)	-0,02 (0,01)*
PR x $\log_2$(average district magnitude[a])			0,0113 (0,0015)***	0,14 (0,03)***
PR x district magnitude variability			0,0088 (0,0052)	
PR x Turnout variability[b]			-0,1954 (0,0377)***	
PR x $\log_2$(number of parties) [b]				-0,46 (0,02)***
Adjusted R2	0,209	0,344	0,450	0,875
AIC	-9895,96	1441,68	-10634,63	-1958,13
N	2054	2054	2054	2054

*** p<0,001

Note: Constant represents a municipality with 20 thousands inhabitants, under majoritarian system, with 5-seat districts only, with SD of turnout and $\log_2$(number of parties) set for the average value in the population.

[a] In order to simplify the interpretation of models, before taking the logarithm, the values of these variables were divided: number of inhabitants by 20,000, district magnitude by 5.

[b] Variables are centered (with the use of average value for all investigated municipalities)

The most important predictor of WDD is, quite obviously, the average number of parties contesting the elections, which represents the fragmentation of local party systems (Beta = 0,70). The more actors compete for the seats, the more "wasted votes" in the elections impact within-district disproportionality.

The most important predictor of BDD is, on the other hand, the turnout variability (Beta = 0,41). According to our assumptions, it has a positive impact on this component of disproportionality. It is worth noticing that the inequality of vote strength between districts is conditioned primarily by the factor which remains uncontrolled by the electoral system design (the territorial variance of turnout level stems from the individual voting behavior).

The size of the municipality (measured by the number of inhabitants) does not impact significantly any of the components of disproportionality. Therefore, it seems that the impact of size is only mediated by the features of electoral system.

These findings are slightly modified by the interactions which were included to the model in order to demonstrate the differences between PR and FPTP system. In general, the significant interactions have opposite signs than the variables interacting with PR system; it means that under the PR system the effects presented above are weaker than under the FPTP system. In case of BDD, the effect of district magnitude almost disappears under PR system, and the effect of turnout variability is considerably weaker. In case of WDD, the effect of district magnitude is reduced almost to half (B=-0,32 in FPTP, B=-0,18 in PR municipalities) and the effect of party system fragmentation is reduced even more – from 0,62 in FPTP to 0,17 in PR. Generally, these findings demonstrate the robustness of PR systems to various sources of disproportionality.

Conclusions and hypotheses for further research

In our paper we demonstrated that the disproportionality can be conceptualized as a measure of inequality if we treat political representation as a good unequally distributed among citizens. The inequality of this distribution – disproportionality – depends on where citizens cast their votes and which party they are voting for. Following this approach, we proposed a measure of disproportionality, the coefficient of variation of representation *per capita*, which could be decomposed into two components of disproportionality: stemming from the seat

apportionment between districts (BDD) and seat apportionment within electoral districts (WDD).

We have found that disproportionality in Polish local elections is caused predominantly by the seat apportionment within electoral districts (WDD), what means that electoral districting in 2010 generally preserved the equality of voters living in various territorial units; simultaneously, territorial variation of turnout did not bias systematically the "vote strength". Of course, the dominance of WDD should not be surprising; however, we demonstrate how the ratio between two components of disproportionality could be measured and controlled. The proponents of majoritarian systems would like to minimize BDD, the proponents of PR systems would like to minimize both components. At this stage of our project, we have no comparable estimations of BDD and WDD from other elections, what would allow us to give more substantial meaning to the particular values of proportion between these two components of disproportionality. However, we plan to use the approach presented in this paper to assess the changes of disproportionality between 2010 and 2014 local elections in Poland.

There is a significant difference in disproportionality between FPTP and PR systems used in Polish local elections – elections in larger municipalities using PR system are more proportional. However, this simple effect of electoral rule can be described more precisely if we take into account separate effects of district magnitude (and its variability), usage of single-member districts, local party system fragmentation and territorial variability of turnout. It seems that while the direction of these effects is generally the same under proportional and majoritarian rule, their strength differs visibly. For example, our analyses demonstrate that the well-known effect of district magnitude (larger electoral districts diminish disproportionality) is generally stronger under FPTP rule than under PR system.

Furthermore, the analysis of disproportionality in 2010 local elections allows to formulate some preliminary hypotheses concerning the forthcoming 2014 elections which will be held under new electoral code.

Firstly, we assume that the spread of majoritarian system in single member districts will increase disproportionality, mainly due to the rise of its within-district component. The main change will be visible in medium-sized municipalities, which change PR system to SMD. We hypothesise that due to the reform BDD will increase as well, as smaller districts can vary

more in terms of "vote strength", despite we found that the "pioneer municipalities" (entirely divided into SMD in 2010 elections) had slightly smaller BDD.

Secondly, we assume that the introduction of new rules will decrease competitiveness of local elections, mainly in small municipalities. In comparison to 2010, in a larger share of electoral districts there will be only one candidate for one seat;, thus citizens will not elect their councillor.

Thirdly, we expect that the reform will affect the representation of women and members of nation-wide political parties. In this paper we purposively omitted the discussion on the relationship between majoritarian rule and representation of various minorities (Trounstine, Valdini, 2008). In Polish case, the significance of ethnic minorities is marginal. However, we assume that after the introduction of SMD the representation of women in city council will be diminished. It is also probable that the elections in SMD will limit the representation of political parties in the councils. In Polish case party members can be treated as a minority group in small and medium-sized municipalities (Gendźwiłł, Żółtak, 2014). We expect the most visible changes in the municipalities which will change the electoral system from PR into SMD (larger than 20,000 inhabitants).

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